“Grain Quality Preservation through Best Practice Grain Storage Management”

IAOM 2023, Ho Chi Minh City, Vietnam

Management and Storage for AGRI and POST-HARVEST INDUSTRY

Engineering growth...

AGI

AGI Global Presence

CAD$ 1.6 Billion

Silos
49,000 +

MH
10,000 +

Dryers
2,000 +

GLOBAL OPERATIONS
WITH REGIONAL HUBS

Canada 10

NORTH AMERICA

USA 10

Italy 06

EMEA

India 04

AGI APAC

Brazil 01

SOUTH AMERICA

30 Manufacturing Facilities
Present in over 100 Countries

Complete Grain Storage Solutions

Grain Storage Systems

Best Design
Best Fit

EUROPE	USA	CANADA	BRAZIL
			
AGI FRAME	AGI MFS	AGI WESTEEL	AGI BRASIL
			
AGI PTM	AGI BROWNIE	AGI TWISTER	AGI BRASIL

PORTABLE SILO LOADING

COLLECTION POINTS

FLAT STORAGE

SPECIALISED CONVEYING


Collection
Points


SPECIALISED
CONVEYING


Canopus
Romania

Hanh Phuc

Vietnam

40 FP 22/15
6 FH 7/16
4 FH 7/16
4 FH 7/16


Rebisco
Philippines


Comvex
Ukraine


Swiss Pasta
Egypt


ВАГОВА
STOP
Nibulon
Ukraine


Orexim
Ukraine


Cofco
Ukraine

Safe Storage

grain quality preservation through best practice grain management


How safe is your most valuable inventory...
25% of crops worldwide are contaminated with mycotoxins

What Impacts on Grain Quality & Grain Losses...

Enemies of Grains

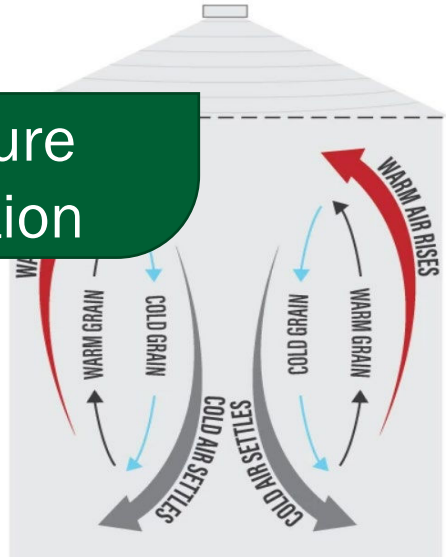
- Impurities & Contaminants
- Moisture Content (shrinkage)
- Moisture Migration (EMC)
- Insect & Infestation Activity
- Fungus, Mould & Toxins
- Discoloured Kernels (paddy)

Impact of Physics Behaviour

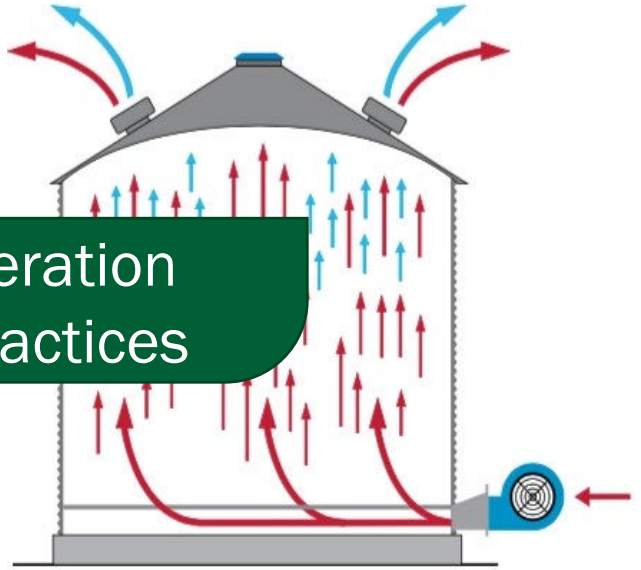
Weather Conditions

Water Leaks

Condensation



Moisture Migration



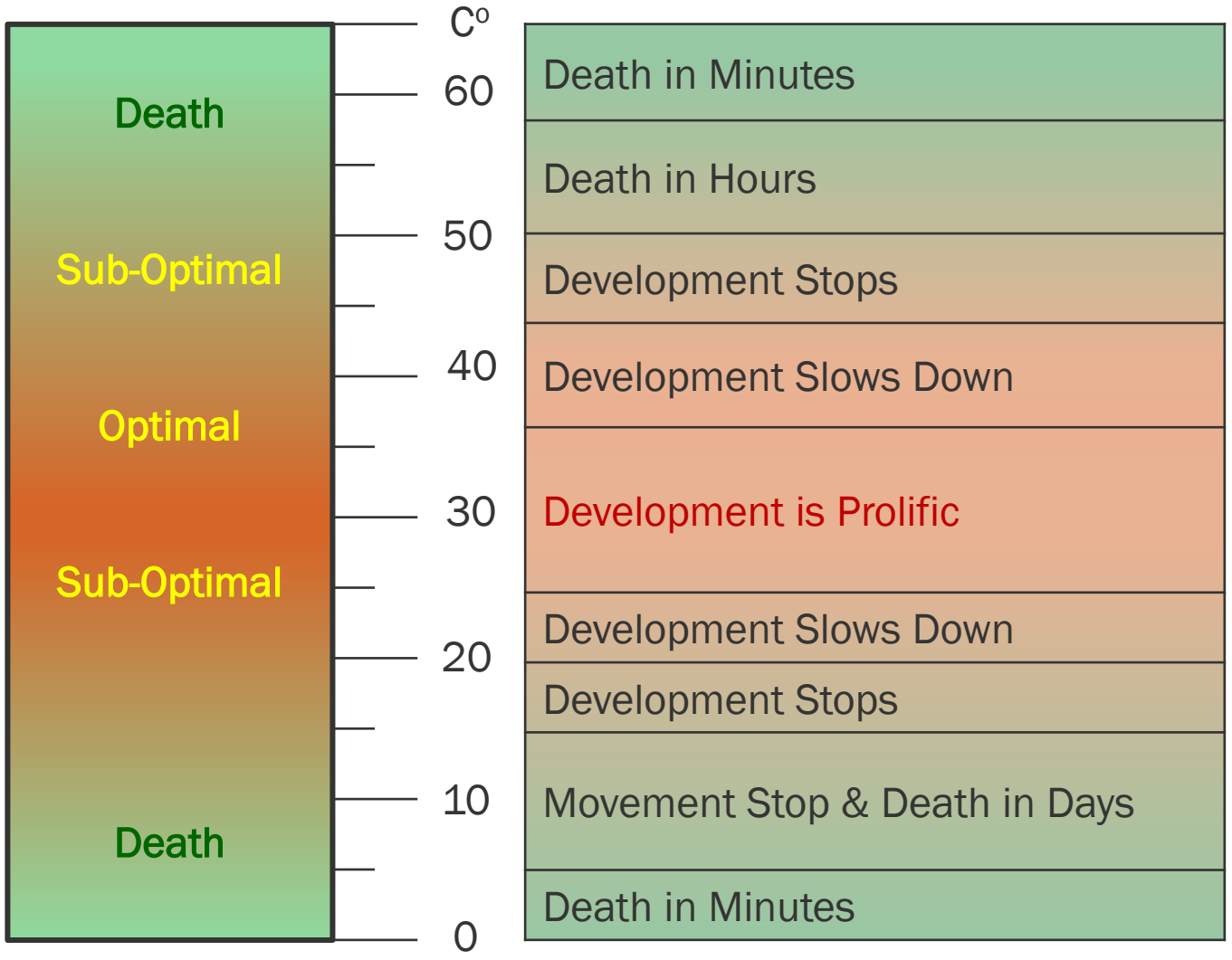
Aeration Practices

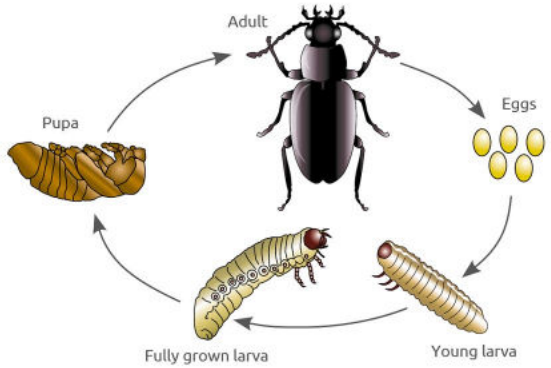
- *Grain Quality*
- *EMC*
- *Respiration*

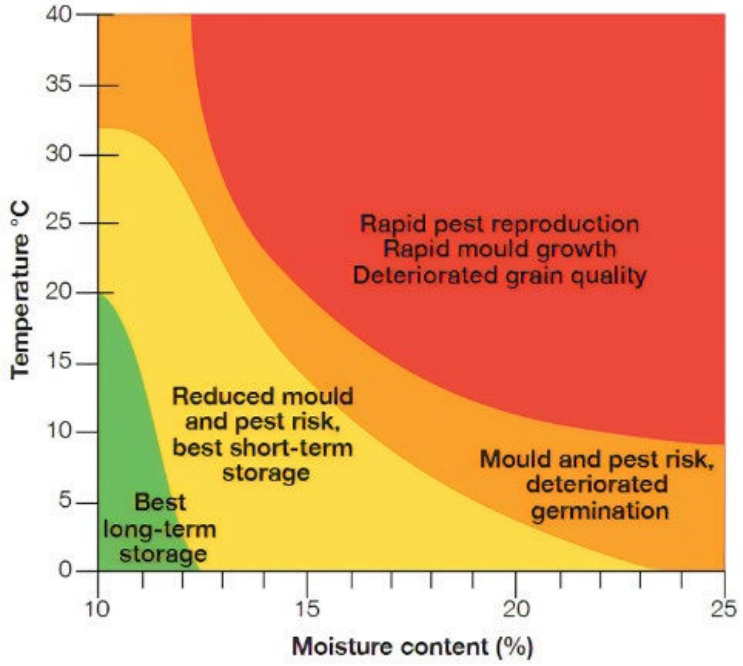
...and many more...

Impact of Temperature

Keep it cool....

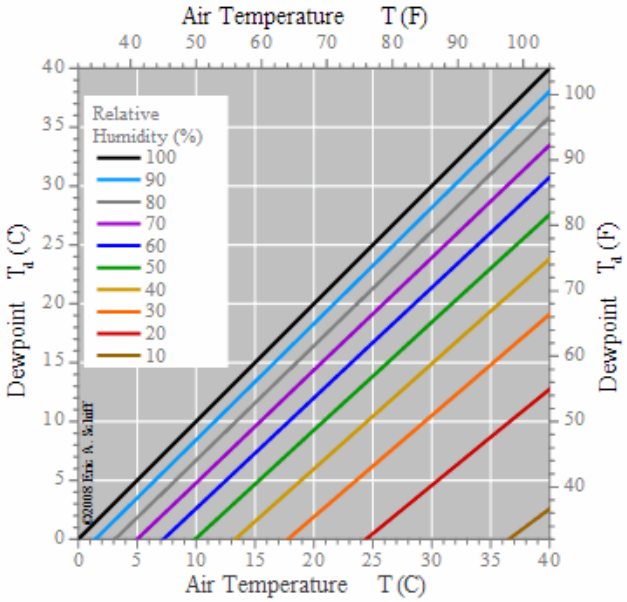


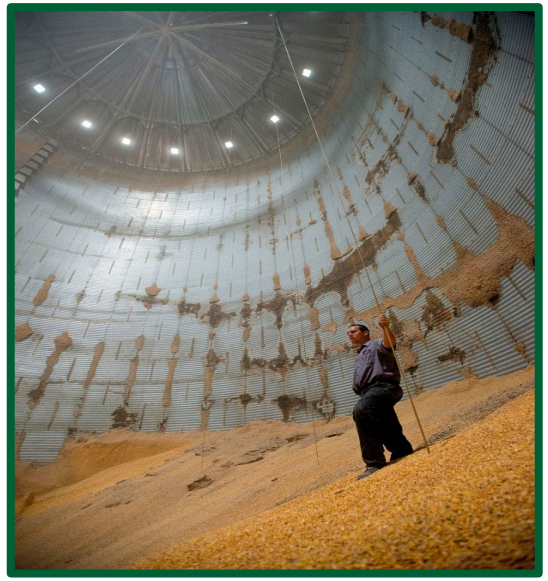




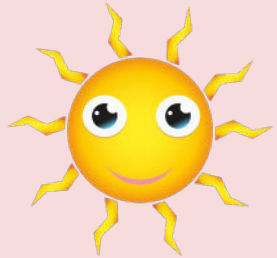
Impact of Dew Point (condensation)

Cold Outside





Warm Outside



Impact of Weather Conditions

Introducing EMC

dry temperate climate

- **Dry** and **Warm** summers
- **Dry** and **Cold** winter
- **Rains** mostly in winter

humid tropical climate

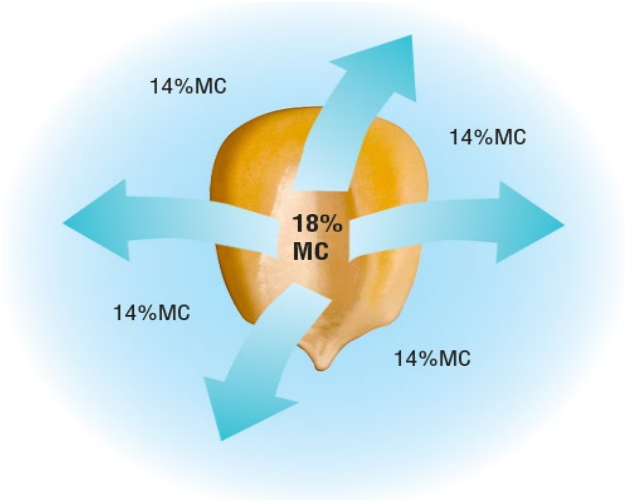
- **Humidity** > 70%
- Heavy **Rainfall**
- **Humidity** can climb to **Saturation**
- Unfavourable EMC

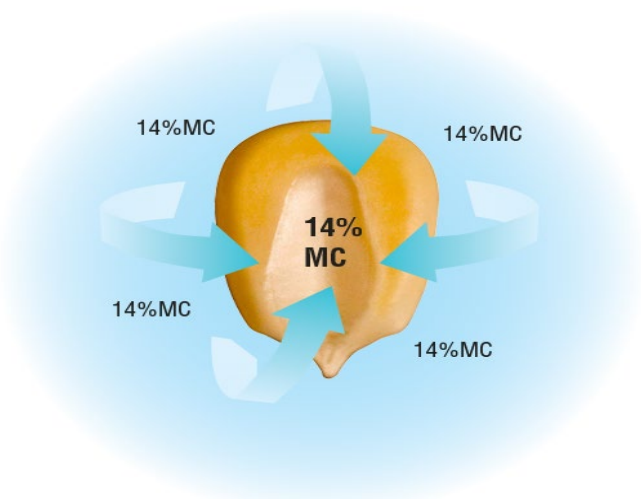
Equilibrium Moisture Content (EMC)

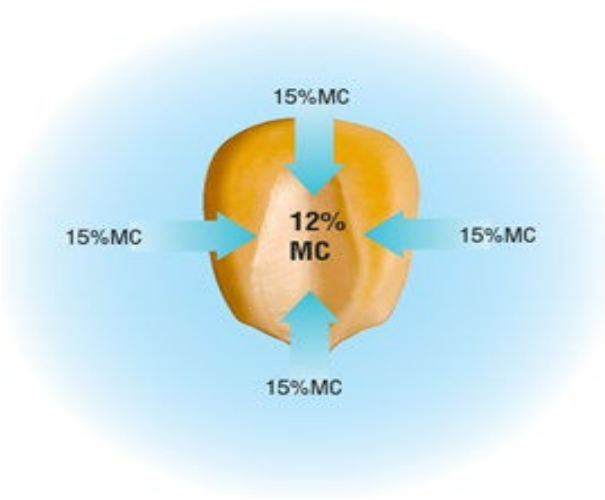
Impact of EMC

Moisture content of grains will equalise when exposed to air with specific

Relative Humidity and **Temperature**



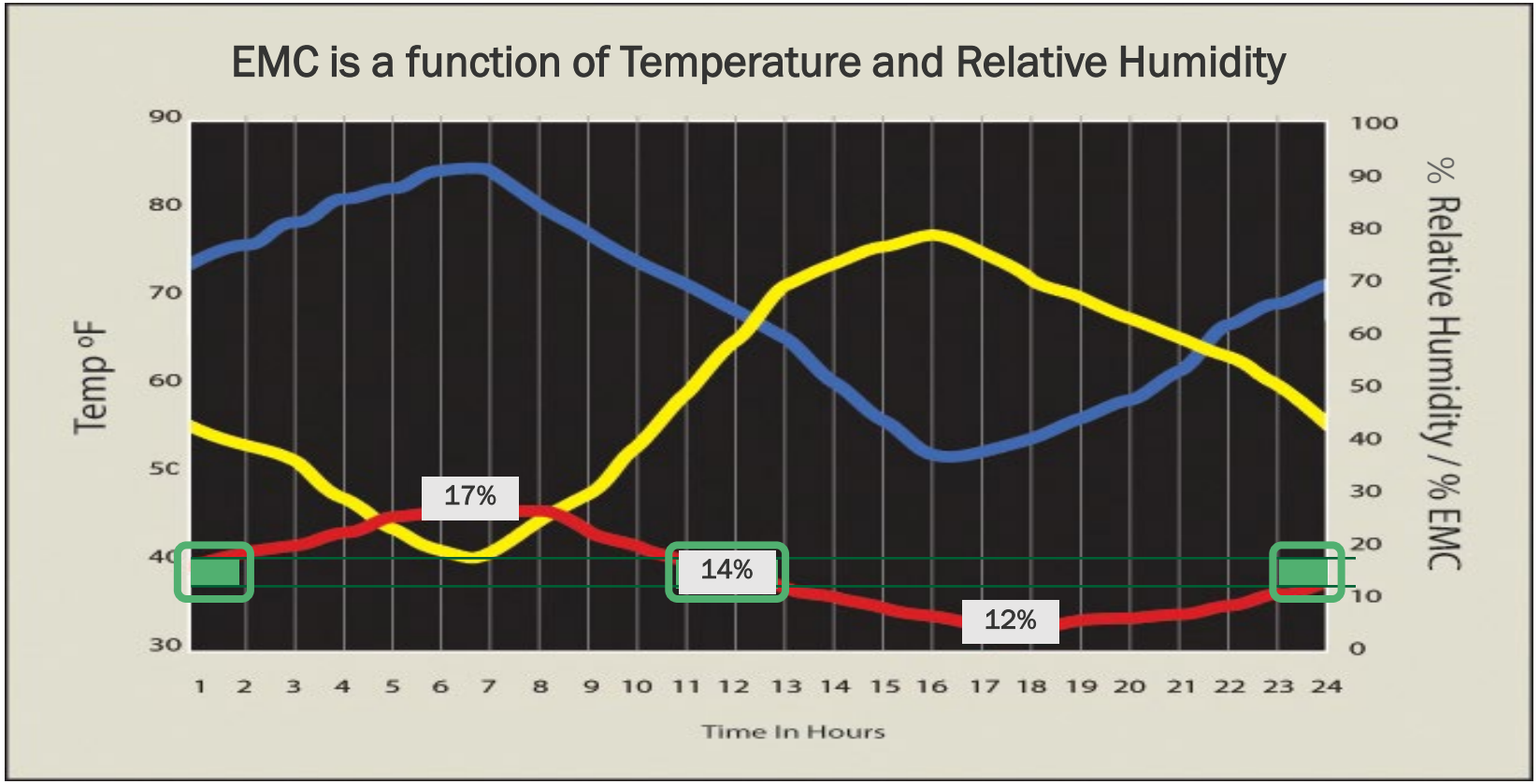




When is it **safe** to operate the silo aerations system, and when it is **not safe...**

never blow humid air into dry grain.....never blow warm air into cooler grain

EMC over 24 hours



Ambient temperature

Relative humidity

Resulting EMC

EMC will impact on the **time of the day** the **aeration runs.**

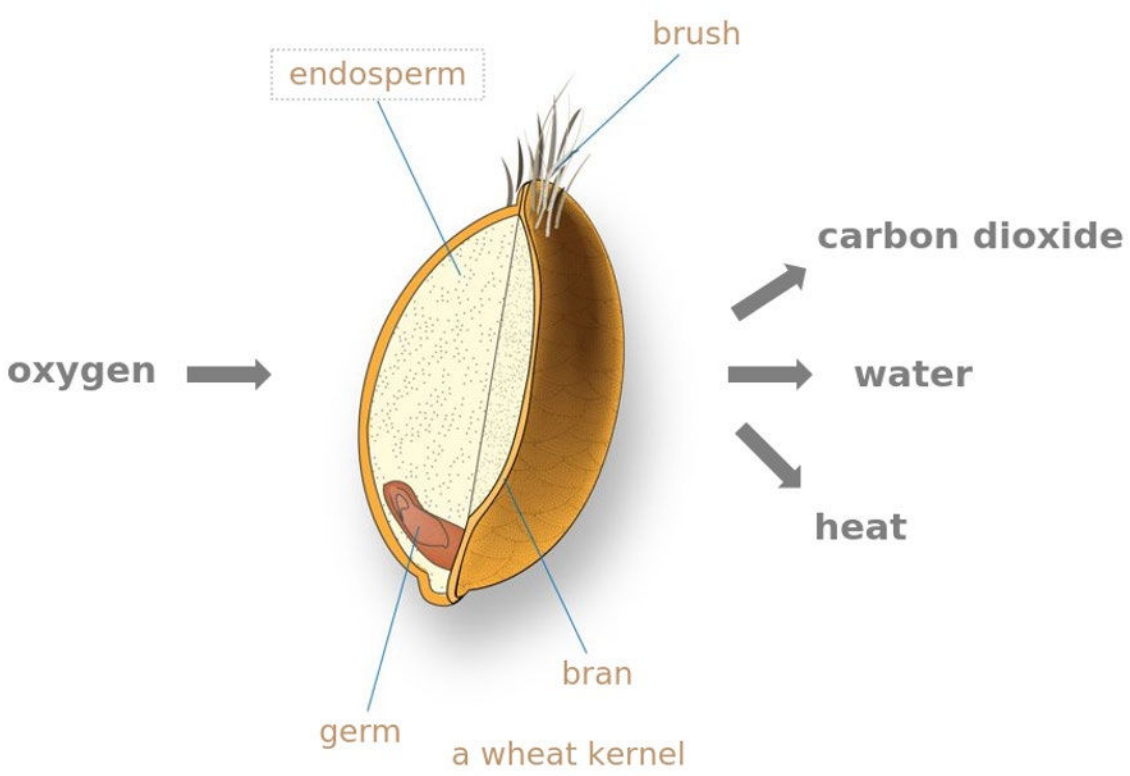
EMC table

Temperature		Relative Humidity (%)									
		10	20	30	40	50	60	65	70	80	90
C	F	Equilibrium moisture content, %wb									
1.7	35	7.3	8.9	10.2	11.3	12.3	13.4	14.0	14.7	16.1	18.2
4.4	40	7.1	8.7	10.0	11.1	12.1	13.2	13.8	14.4	15.9	18.0
10	50	6.8	8.4	9.6	10.7	11.8	12.9	13.4	14.1	15.5	17.6
16	60	6.5	8.1	9.3	10.4	11.4	12.5	13.1	13.7	15.1	17.2
21	70	6.2	7.8	9.0	10.1	11.1	12.2	12.8	13.4	14.8	16.9
25	77	6.0	7.5	8.7	9.8	10.9	11.9	12.5	13.1	14.5	16.6
32	90	5.8	7.3	8.5	9.6	10.6	11.6	12.2	12.8	14.2	16.3

indicative figures

Impact of Respiration

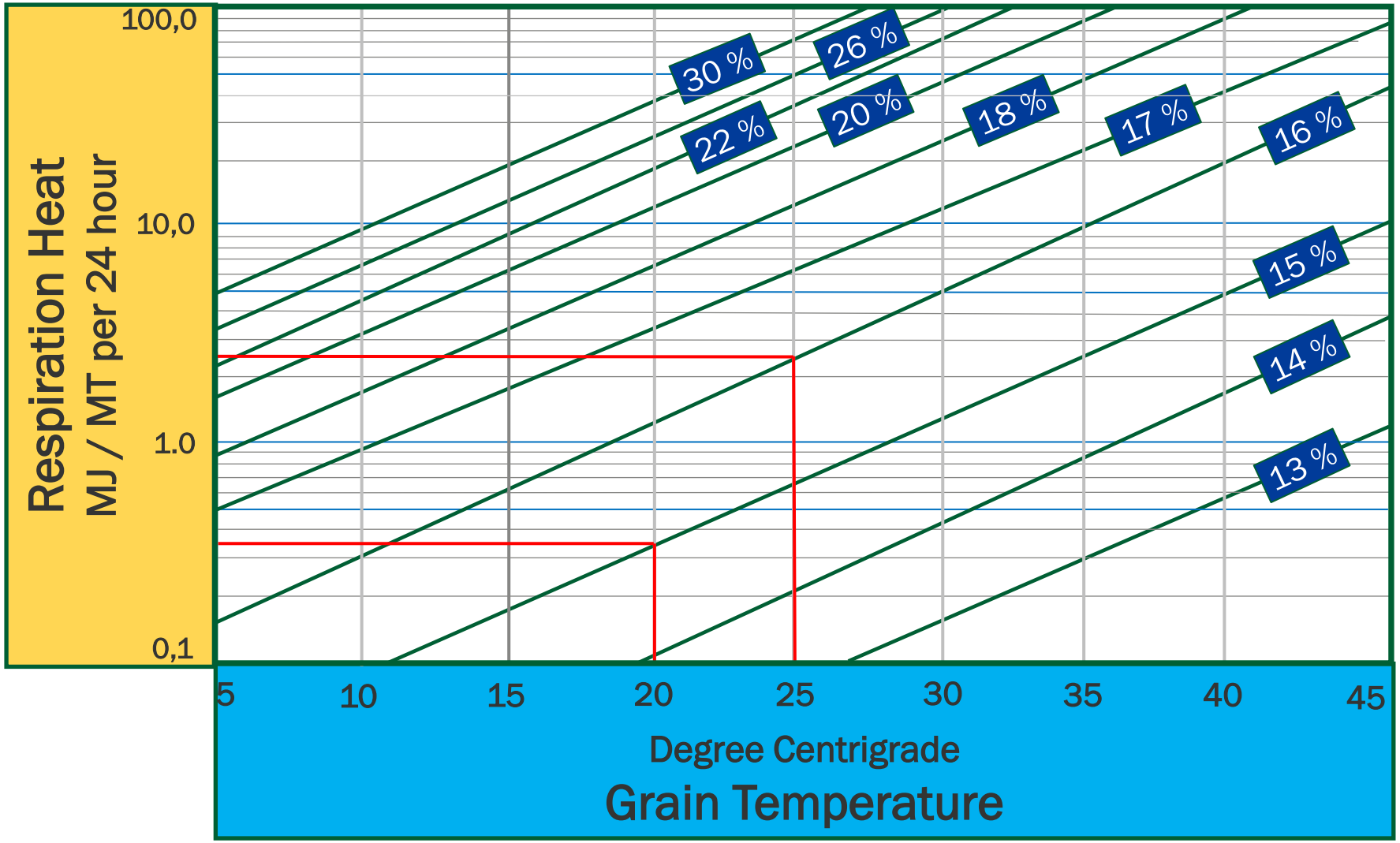
Grain lives...!



- Breathes
- Moisture Release
- CO_2 Release — CO_2 Sensor
- Heat Development

carbohydrates	+	oxygen	→	carbon dioxide	+	WATER	+	HEAT
1,000 g	+	1,123 g	→	579 g	+	1,544 g	+	16.48 MJ

Impact of Heat Development



The lower the temperature and moisture content of the grain,

the longer the safe storage time !

Grain Losses

The higher the temperature & moisture content, the higher the heat of respiration.

Respiration heat and moisture are released into the grain mass.

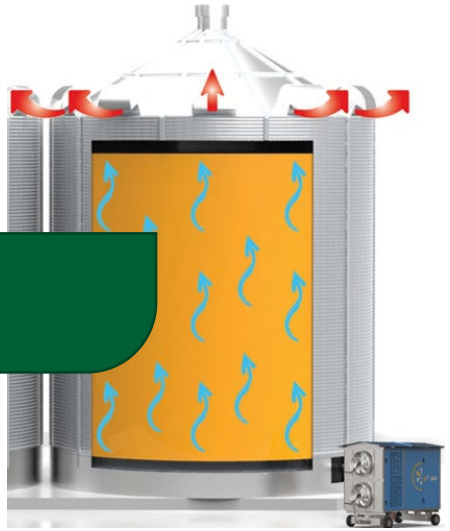
Grain Management Tools

Grain Management Tools

Temperature Monitoring Systems

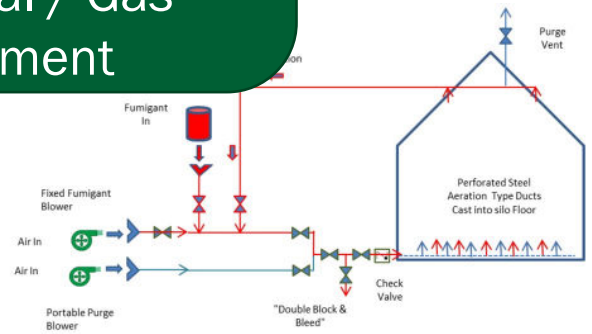
Product Turnover (recycle)

Conditioned (chilled) Air

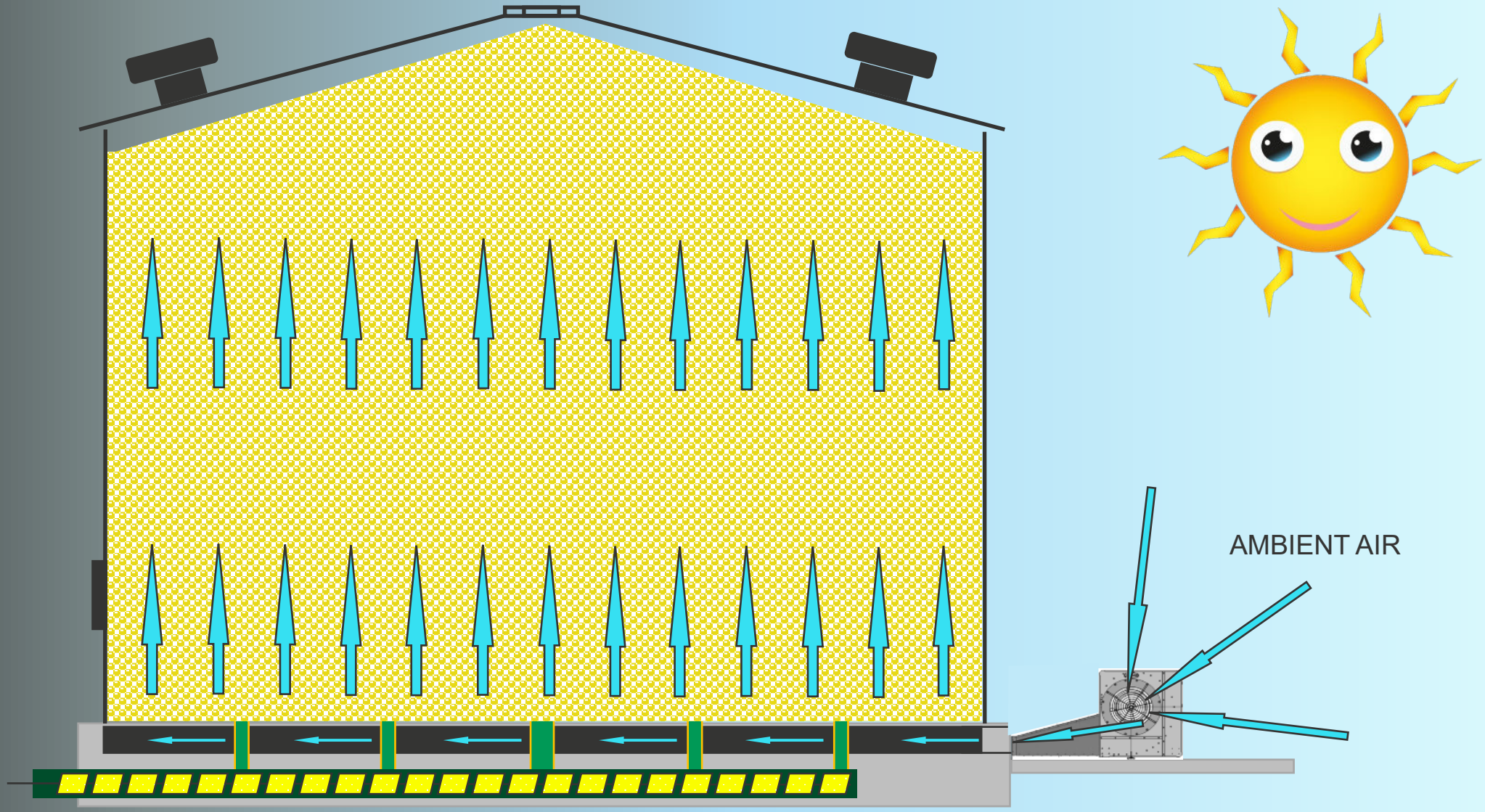


Ambient Air Aeration

Chemical / Gas Treatment



Ambient Air Aeration....



Aeration Considerations

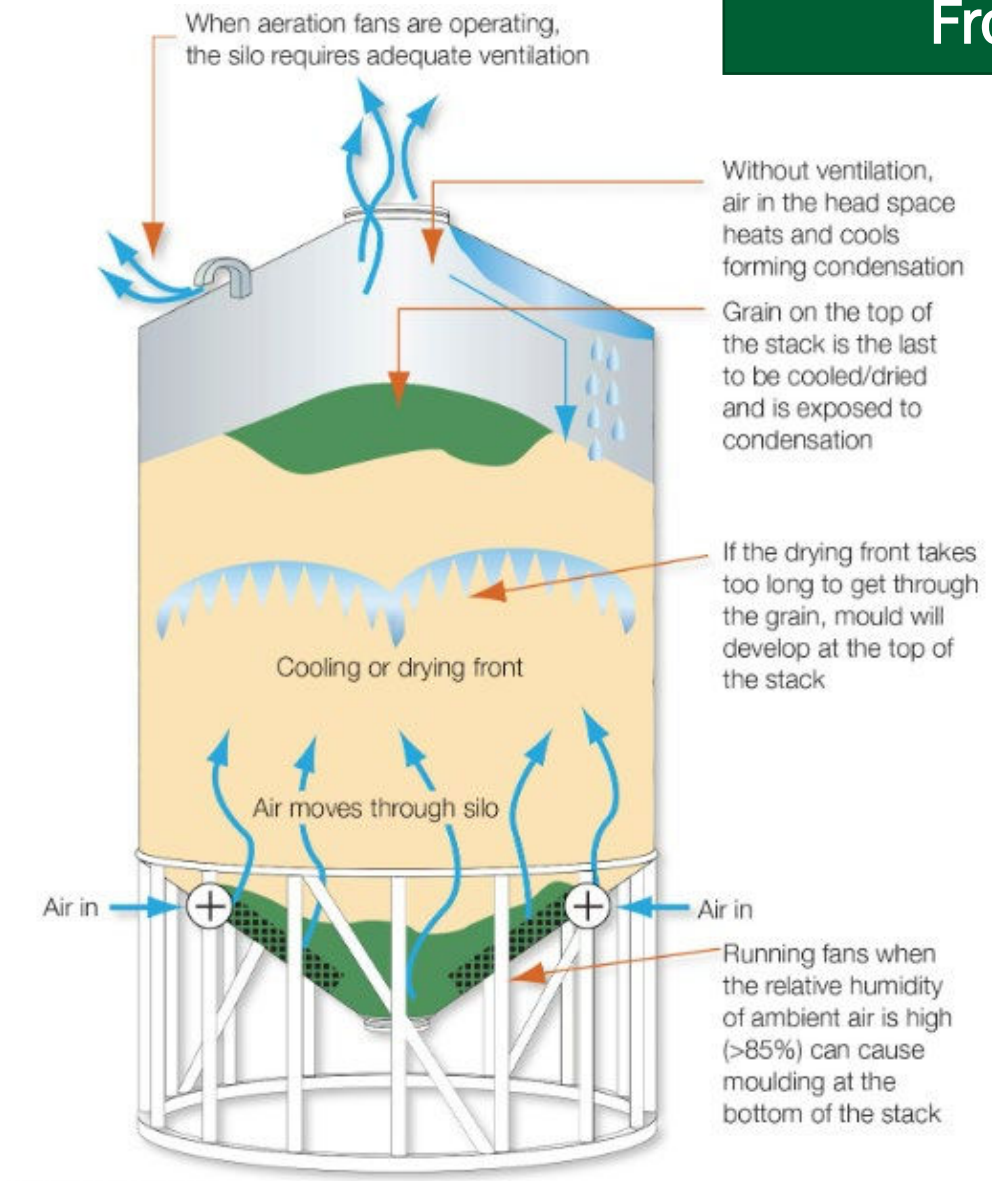
Correct Ventilation

Day / night Temperatures Difference will cause Condensation

Aeration Layers (fronts)

Mould Development

Aeration Fronts



Source: Kondinin Group

When is it safe to do aeration…rule of thumb

Relative Humidity inside the grain bulk
→ < 65%

Ambient Relative Humidity
→ < 65%

Ambient Temperature
→ at least 5° C lower than grain temperature

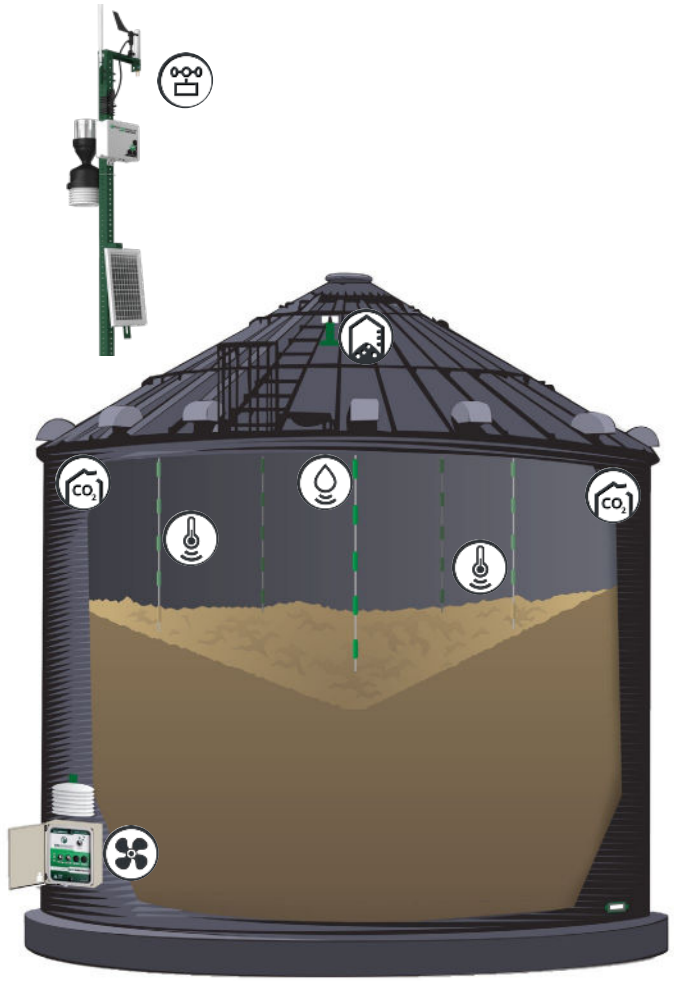
Aeration or NO Aeration

Answer is
NO

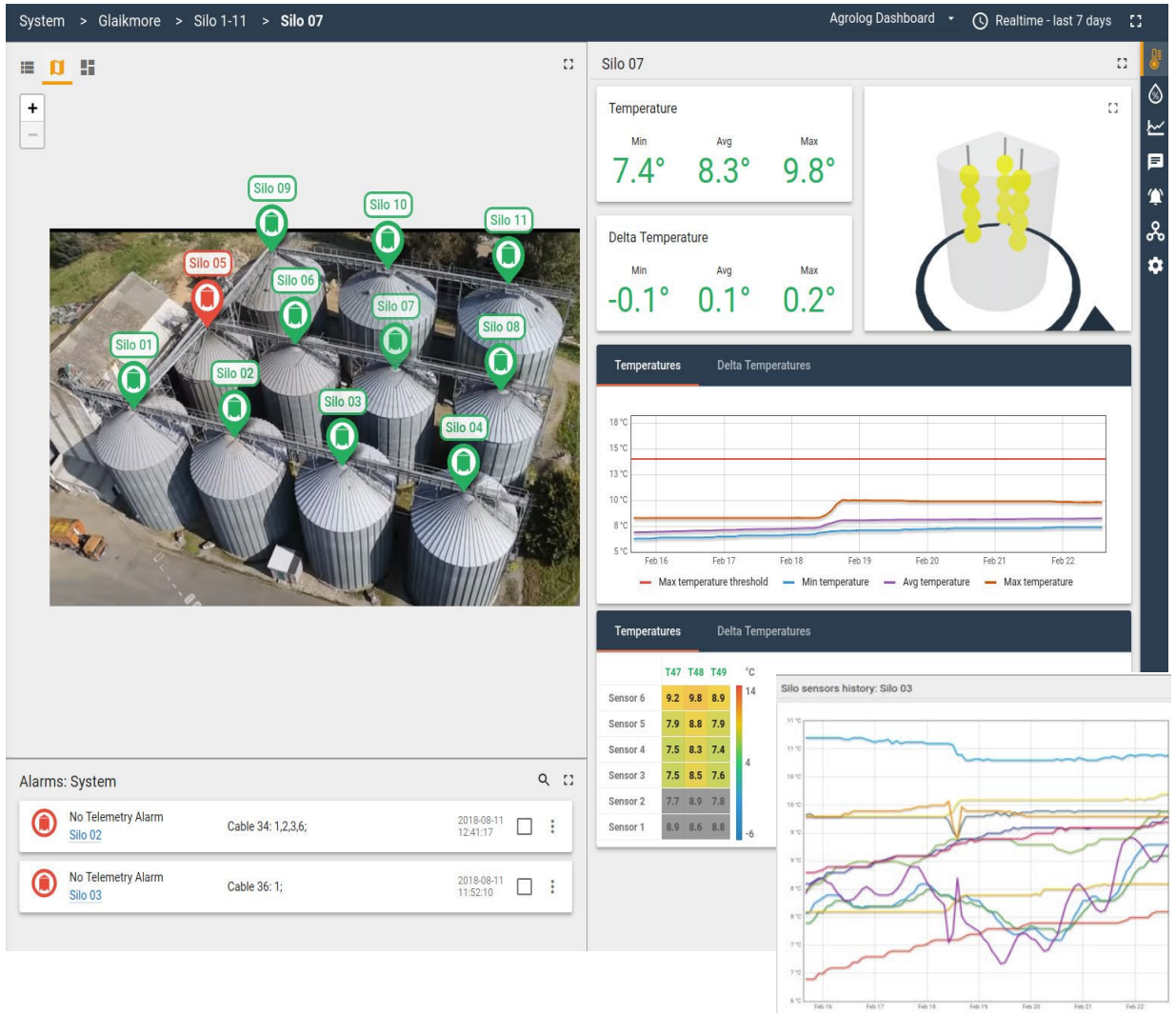
Grain Monitoring

What are the components (sensors)

- Temperature Monitoring - **avoid spoilage in your grain by detecting hotspots**
- Moisture Monitoring - **for better storage quality and safety**
- Level Monitoring - **tracking inventory in silos is an important component**
- Aeration Control - **automatic fan control optimizes grain quality**
- Ambient Monitoring - **monitoring weather conditions provides great control for aer**
- Head Space Monitoring - **avoid condensation and wet grain on the grain surface**
- CO2 Monitoring - **CO2 sensors can provide early spoilage detection**



Feature & Benefits



Temperature and Moisture Monitoring

- Continuous & real-time reading of your grain condition
- Automated reporting, labour cost reduction

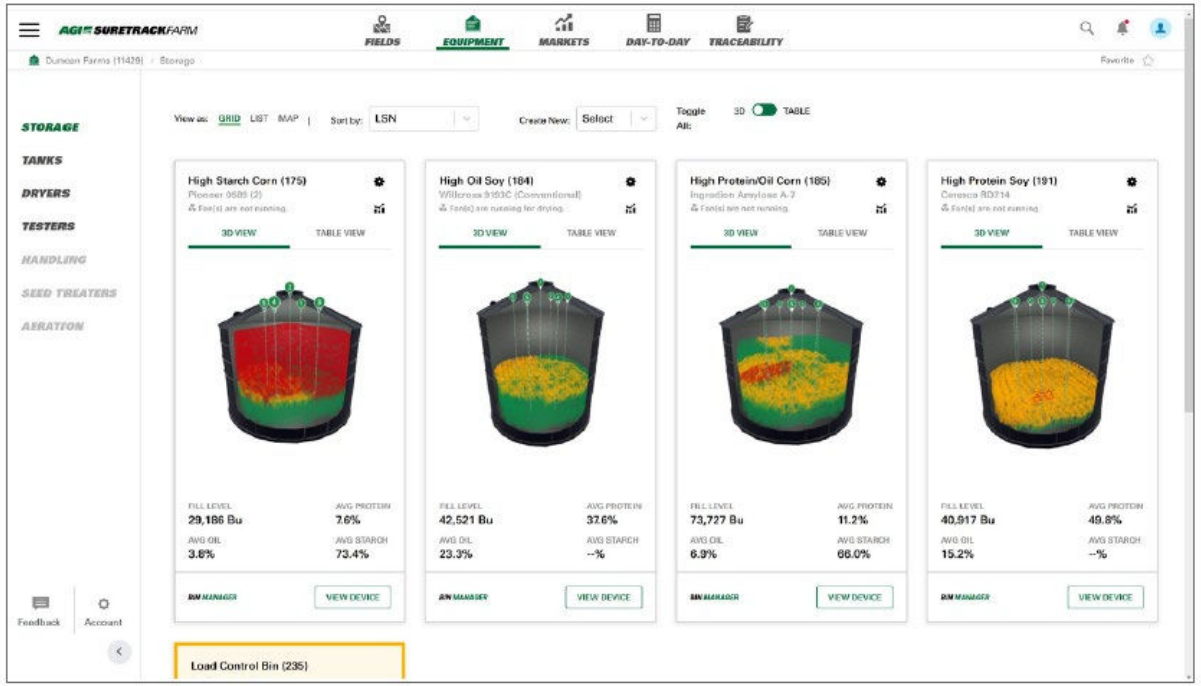
External Weather Station

- Measure weather conditions that affect grain condition
- Measurement of EMC (equilibrium moisture content)

Historical Data Storage

- Long term data analysis, statistical and audit references
- Plant storage performance, analysis and trends

Feature & Benefits



Check your bin activity from anywhere at anytime

Internet Enabled Devices (IoT) / Mobile App

- Real-time viewing of storage complex anywhere / anytime
- immediately notification of any issues, alarm conditions

Inventory Estimate

- Real-time bin inventory (cable sensors)

CO2 Detection

- Monitor elevated CO2 levels for early detection of insect and fungi infestation

Fumigation & Cooling

Fumigation Concepts

Pellet Dosing

Table Dosing

Gas Dosing

Gas Distribution

Grain Cooling....a safe & flexible option

Safe Aeration

Chilled +

De-Humidified

air to SILO

In partnership with....

grainTECHNIK

Each grain matters